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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

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TITLE OF THE INVENTION (280 characters max)

METHOD AND APPARATUS FOR FALSE SYNC LOCK DETECTION IN A DIGITAL MEDIA RECEIVER

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* 4 ☐ CD(s), Number [ ]

☐ Drawing(s) *Number of Sheets* 0 ☐ Other (specify) [ ]

☐ Application Data Sheet. See 37 CFR 1.76

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

☐ Applicant claims small entity status. See 37 CFR 1.27.

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☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: ____.

Respectfully submitted,

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USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C., 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

METHOD AND APPARATUS FOR FALSE SYNC LOCK DETECTION IN A DIGITAL MEDIA RECEIVER

The SCTE DVS-031 and ITU-T J.83B standards, which are nearly identical, describe a digital transmission system for cable distribution of video, sound and data services. The data format input to the physical layer (channel coding and modulation) is assumed to be MPEG-2 transport. However, the method used for MPEG-2 synchronization is de-coupled from the Forward Error Correction (FEC) synchronization, unlike many other digital transmission standards. This feature was intended to introduce the flexibility, for example, to enable the system to carry Asynchronous Transfer Mode (ATM) packets easily without interfering with ATM synchronization. However, an unintended aspect of this feature is the increased probability of false locks in the MPEG-2 synchronization detector. In particular, when the data is quasi-periodic as for example, when there is a substantial number of null packets in the data stream, the MPEG-2 synchronization detector can falsely lock to one of several wrong positions in the packet and send invalid packets to the transport block even when the FEC is perfectly locked and delivers an error free data stream.

In accordance with the principles of the present invention, these false lock conditions are detected by feeding back information from the transport block to the MPEG-2 sync detector and instructing the sync detector to attempt to lock to another position, until the correct one is found.

The instant invention is described in the context of an MPEG-2 synchronization detector with a false lock detector capability in a digital cable receiver compliant with the SCTE DVS-031 and ITU-T J.83B standards, like the U.S. digital cable system. This false lock detector is based on feedback information sent from the transport portion of the receiver to the physical layer portion of the receiver where the MPEG-2 sync is detected. Although described in such a context, the invention should not be construed as being so limited and applies equally to all receiving devices (in addition to cable receivers) in which the problem addressed by the present invention may be applied.

The SCTE DVS-031 and ITU-T J.83B standards describe a digital transmission system for cable distribution of video, sound and data services. In particular, the SCTE DVS-031 describes the adopted standard for digital cable transmission in the U.S. In both standards, the data format input to the physical layer (channel coding and modulation) is assumed to be MPEG-2 transport. The MPEG-2 transport layer is comprised of data packets having 188 bytes, with one byte for synchronization purposes (called sync byte and having a constant value of 47Hex), three bytes of header containing service identification, scrambling and control information, followed by 184 bytes of MPEG-2 or auxiliary data.

In the physical layer, the MPEG transport framing is the outermost layer of processing. This processing block receives an MPEG-2 transport data stream consisting of a continuous stream of fixed length packets that are transmitted in serial fashion, most significant bit (MSB) first. It then locks to the sync byte and delivers MPEG packet synchronization to the following receiver blocks, including the transport block. The output of this block may include an output clock, the data stream, in serial or parallel format, a sync signal identifying the position of the sync byte in the data stream, a valid signal identifying when data is present at the output data stream and an error signal identifying whether the packet is considered invalid (uncorrectable errors) or error free.

Unlike some other digital transmission standards, the method used for MPEG-2 synchronization in the digital cable standards mentioned above is de-coupled from the Forward Error Correction (FEC) synchronization. First, the MPEG-2 packet does not contain an integer number of FEC frames, or even Reed-Solomon (RS) codewords. Hence, the MPEG-2 packets and the FEC frames, or the MPEG-2 packets and RS codewords are asynchronous with respect to each other. Second, the sync byte was replaced at the transmission site by a parity checksum that is a coset of an FIR parity check linear block code. Hence, the MPEG-2 transport framing block needs to decode this parity check block code in order to recover the sync byte and then lock to it.

This MPEG-2 synchronization de-coupling feature was intended to introduce the flexibility, for example, to enable the system to carry Asynchronous

Transfer Mode (ATM) packets easily without interfering with ATM synchronization. However, an unintended consequence of this feature is the increased probability of false locks in the MPEG-2 synchronization detector within the MPEG-2 transport framing block. This happens because the parity check block code is not very powerful and its decoder generally indicates several places in a packet where a possible sync byte could be found, when only one is the correct one. This occurs even when the FEC is perfectly locked and delivers an error free data stream. Luckily, the data stream does not generally present a periodic characteristic and after being processed by the parity check block decoder, different packets will tend to only have the correct sync position in common. However, in the case of a data stream with a considerable number of null packets, for example, this problem becomes evident and the lock detector may lock to one of the wrong positions identified by the parity check block decoder. As long as there are enough null packets multiplexed in the data stream on a regular basis, this may be enough to keep the lock detector falsely locked for a long time. After a lock detection, the MPEG-2 sync detector inserts the sync byte in the position identified by the parity check block decoder, creates the sync signal, the valid signal and error signal and sends the data stream to the transport layer. In the case of a false lock, the transport layer cannot easily identify a wrong packet, since it is receiving 188 data bytes, with a first byte being the sync byte, a valid signal in line with the bytes, and error signal indicating an error free packet.

The present invention detects these false lock conditions by feeding back information from the transport block to the MPEG-2 sync detector and instructing the sync detector to try and lock to another position identified by the parity check block decoder, until the correct one is found. This false lock detection can be identified by a few checks performed at the transport layer:

a) Each MPEG-2 packet has an associated PID field composed of 13 bits contained in the 2nd and 3rd bytes of the packet. If the transport layer is informed.about the valid PID values for a specific application, it can set a flag, the pid_flag, identifying invalid PID's in the data stream.

b) Each MPEG-2 packet has an associated continuity counter field

composed of 4 bits in the 4th byte of the packet. For each valid PID in the data stream, the transport can set a flag, the continuity_counter_flag, identifying a break in the continuity counter in the data stream.

c) Each MPEG-2 packet has an associated transport error indicator field composed of 1 bit in the 2nd byte of the packet. This transport error indicator will most likely agree with the error signal output of the physical layer. In the case of a false lock situation, because the packet is misaligned with respect to the correct data, it is possible that the transport error indicator may be '1', when the error signal is a '0'. This can set a flag, the error_flag, identifying this condition.

Items a), b) and c) above could process the data for a number of packets before setting the respective flags. Once this information is sent back to the transport framing block, it can be correlated against the fact that the MPEG-2 sync detector is locked and the FEC shows perfect error-free lock to instruct the MPEG-2 sync detector to skip to the next possible position for a sync byte identified by the parity check block decoder and restart the sync process. Since there are only a few wrong positions in the packet, this process can achieve correct lock within a relatively small number of packets.